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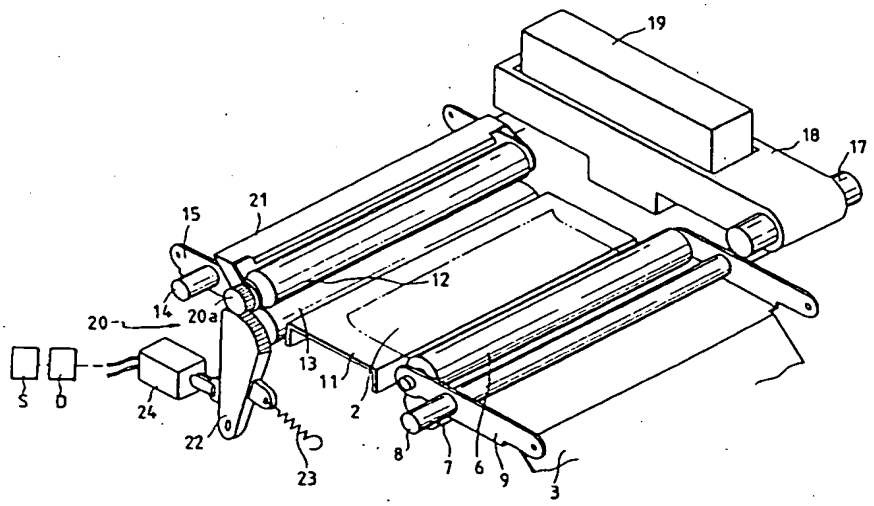
(54) Recording apparatus.

(57) A recording apparatus comprising a platen for supporting a sheet at a recording area, feeding means for feeding the sheet to the platen, recording means for recording an image on the sheet at the recording area, and an urging member disposed at a downstream side of the recording area and adapted to urge the sheet against the platen.

FIG. 1



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BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a recording apparatus which can prevent the floating of a recording sheet.

Related Background Art

In the past, a kind of sheet feeding device incorporated into an ink jet printer and the like comprises a pick-up roller for feeding out sheets stacked in a cassette one by one, a pair of feed rollers for pinching the fed sheet and for feeding the sheet to a platen, and a pair of ejector rollers for removing the sheet from the platen after an image has been printed on the sheet. In this sheet feeding device, the sheet fed out by the pick-up roller is pinched by both feed rollers and the ejector rollers forwardly and rearwardly of the platen, and the recording or printing is effected while a carriage mounting a recording head thereon is scanning the sheet. Meanwhile, the sheet is line-spaced by means of the rollers by a predetermined amount for each printing line, and, when all of the printing lines are recorded, the sheet is ejected by the ejector rollers.

However, in such a sheet feeding device, since the printing operation is performed after the sheet is pinched by the feed rollers and the ejector rollers disposed forwardly and rearwardly of the platen, there arose a problem that a blank portion which could not be recorded was left at a leading portion of the sheet.

On the other hand, there are recording apparatuses wherein the recording is started before the leading end of the recording sheet is pinched by the ejector rollers. However, in these recording apparatuses, depending upon the environment such as the surrounding temperature and/or humidity and the recording condition, the leading end of the sheet is curled to float from the platen. As a result, the curled sheet may contact the recording head to smear the sheet or may ride over the ejector rollers or may be folded at its leading end. In order to prevent the floating of the leading end of the sheet, there were proposed an electrostatic attracting means or a suction means such as a pump disposed on or in the platen. However, such means made the apparatus expensive and large-sized.

Further, in the past, as shown in Fig. 22, an elastic sheet hold-down member 50 is attached to a fixed guide 52 for guiding the movement of a carriage 51 whereby the sheet hold-down member 50 holds down a recording sheet 54 at a recording area below a recording head 53 to prevent the floating of the sheet 54.

However, if the sheet hold-down member 50 always contacts with the recording sheet 54 as shown in Fig. 22, the accuracy of the feeding of the sheet will often be badly influenced. Further, if the leading end of the recording sheet 54 is curled upwardly, the leading end of the recording sheet is floated before the leading end is pinched by a pair of ejector rollers 56, thus causing the contact between the recording sheet 54 and the recording head 53. To avoid this, the recording is effected after the leading end of the recording sheet has been pinched by the ejector rollers, thus generating a longer blank area at the leading end portion of the recording sheet.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a recording apparatus which can eliminate the above-mentioned conventional drawbacks, to prevent the floating of a recording sheet without worsening the feeding of the recording sheet, to minimize a blank portion on which the recording is not effected, and to prevent the contamination of the recording sheet with ink.

In order to achieve the above object, the present invention provides a recording apparatus comprising a recording means for performing the recording with respect to a recording sheet fed onto a platen, and a sheet hold-down member disposed at a downstream side of the platen and adapted to urge the recording sheet against the platen.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a perspective view of a recording apparatus according to a preferred embodiment of the present invention;

Fig. 2 is an elevational sectional view of the recording apparatus of Fig. 1;

Fig. 3 is a perspective view of a recording apparatus according to a second embodiment of the present invention;

Figs. 4 and 5 are elevational sectional views showing the operation of a sheet hold-down member;

Figs. 6 and 7 are block diagrams for the mode setting;

Fig. 8 is an elevational sectional view of an ink jet recording apparatus according to a third embodiment of the present invention;

Fig. 9 is a perspective view of the ink jet recording apparatus of Fig. 8;

Fig. 10 is an elevational sectional view showing a condition that a sheet hold-down member is separated from a platen;

Fig. 11 is an elevational sectional view showing a condition that a recording sheet is urged against a platen by the sheet hold-down member;

Fig. 12 is an elevational sectional view for explaining a condition that the recording is effected with respect to a recording sheet on which ink is dried slowly;

Fig. 13 is an elevational sectional view of an ink jet recording apparatus according to a fourth embodiment of the present invention;

Fig. 14 is a perspective view of the ink jet recording apparatus of Fig. 13;

Fig. 15 to 19 are elevational sectional views for explaining the operation of a sheet hold-down member;

Fig. 20 is an exploded perspective view of a recording head;

Figs. 21A to 21G are explanatory views for explaining a bubble jet recording principle; and

Fig. 22 is a sectional view of a conventional sheet hold-down mechanism.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figs. 1 and 2 are a sectional view and a perspective view of a recording apparatus according to a first embodiment of the present invention, respectively.

A pick-up roller 5 is provided for separating an uppermost sheet from sheets 2 stacked in a cassette 1 and for supplying and feeding the uppermost sheet between an upper guide 3 and a lower guide 4. Whenever the pick-up roller 4 is rotated by one revolution, it is stopped at a position shown in Fig. 2 to release a sheet feeding force; however, before the completion of one revolution of the pick-up roller, a leading end of the sheet is pinched between an upper feed roller 6 and a lower feed roller 7. Thereafter, the sheet is conveyed by these upper and lower feed rollers 6, 7. The upper feed roller 6 is urged against the lower feed roller 7 by a spring 10 via a pressure plate 9 pivotally mounted on a shaft 8, so that the upper feed roller is driven in synchronous with the rotation of the lower feed roller. When the sheet 2 is detected by a sensor S, the lower feed roller 7 starts to be rotated by a pulse motor (not shown) to feed the sheet 2 step by step.

At a downstream side of a platen 11, there are disposed upper and lower ejector rollers 12, 13 which cooperate with each other to pinch the fed sheet 2 therebetween. The upper ejector roller 12 is urged against the lower ejector roller 13 by a spring 16 via a pressure plate 15 pivotally mounted on a shaft 14, so that the upper ejector roller is driven in synchronous with the rotation of the lower ejector roller. Further, since it is so selected that the lower ejector roller 13 is rotated at a peripheral speed faster than that of the lower feed roller 7 by a few percents (%), the sheet 2 on the platen 11 is always tensioned properly not to be slacked.

Above the platen 11, there is disposed a movable carriage 18 which can be shifted along a rail 17 arranged transversely of a sheet feeding direction and on which a recording head (recording means) 19 is mounted.

Next, a sheet hold-down member 20 which forms a part of the present invention will be explained.

A gear 20a is rotatably mounted on an axis same as that of the upper ejector roller 12, and a sheet hold-down plate 21 capable of being urged against the platen 11 is secured to the gear 20a. A rotatable gear lever 22 is meshed with the gear 20a. A return spring 23 and a solenoid 24 are attached to the gear lever 22 at opposite sides thereof. When the solenoid 24 is not energized, the sheet hold-down plate 21 is situated at a position (shown in Fig. 1) spaced apart from the platen 11 by means of the return spring 23; whereas, when the solenoid 24 is energized, the gear lever 22 is rotated to rotate the gear 20a, thereby urging the sheet hold-down plate 21 against the platen 11.

Next, an operation of the apparatus according to the embodiment having the above-mentioned arrangement will be explained.

The uppermost sheet on the sheet stack 2 rested in the cassette 1 is fed out by the pick-up roller 5. The fed sheet 2 is guided between the upper and lower guides 3, 4 and is then pinched by the upper and lower feed rollers 6, 7, and then is fed onto the platen 11. In this case, the carriage 18 on which the recording head 19 is mounted is waiting at a side of the platen 11. As shown by a phantom line in Fig. 1, the leading end of the sheet 11 fed on the platen 11 is often curled to float from the platen. When the fact that the leading end of the sheet reaches a position where the leading end of the sheet is held down by a central portion (in the sheet feeding direction) of the sheet hold-down plate 21 is determined or discriminated by counting the pulse numbers of the pulse motor for driving the feed roller 7 by means of a counter means D, the solenoid is energized to generate the attraction force, thereby rotating the gear lever 22. As a result, the sheet hold-down plate 21 is also rotated via the gear 20a, thus urging the leading end of the sheet 2 against the platen 11.

In this condition, the carriage 18 mounting the recording head 19 thereon performs the scanning action along the rail 17 to print one line. In this way, it is possible to minimize a blank portion at the leading end portion of the sheet. After the one-line printing is finished, the sheet 2 is fed by a

predetermined amount (line space) to prepare for the next one-line printing. In this case, by feeding the sheet step by step while the sheet hold-down plate 21 is being urged against the sheet 2, the leading end of the sheet can be smoothly pinched between the upper and lower ejector rollers 12, 13. That is to say, if the sheet hold-down plate 21 is released or opened, the leading end of the sheet will be floated again. In this condition, if the sheet is further fed, the sheet will ride on the upper ejector roller 12 or the front corner or corners of the sheet will be folded. However, by providing the sheet hold-down plate 21, such inconvenience can be avoided.

After the fact that the sheet 2 is pinched between the upper and lower ejector rollers 12, 13 is discriminated by counting the pulse numbers of the motor regarding the lower feed roller 7, since the sheet hold-down plate is not required, when the recording head 19 returns to its waiting position, the attraction force of the solenoid 24 is released, with the result that the sheet hold-down plate 21 is retarded, by the return spring 23, to a position where the sheet hold-down plate does not interfere with the scanning action of the carriage 18.

After the printing of the desired whole area of the sheet is finished by repeating the line spaces of the sheet and the one-line printings by means of the recording head 19, the sheet 2 is ejected onto an ejection tray 25 by the ejector rollers 12, 13, thus completing the sequential printing operation.

Incidentally, when a sheet such as a plastic sheet on which the drying of the ink is delayed is used as the recording sheet, a mode wherein the solenoid 24 is not retarded (i.e., the attraction force thereof is not released) may previously be selected so that the sheet hold-down plate 21 is not smeared with the non-dried ink. Further, as proposed in the Japanese Patent Laid-open No. 2-293154, the upper ejector roller may be divided into plural roller portions in an axial direction, and only roller portions associated with the printing area may be pivoted to be separated from the lower ejector roller.

The selection of this mode is effected as follows:

As shown in Fig. 6, a switch a is manipulated depending upon the material of the sheet 2, and the solenoid 24 is controlled via a control device b on the basis of a signal from the switch. That is to say, the sheet hold-down plate 21 is released without the energization of the solenoid 24.

Alternatively, as shown in Fig. 7, a sensor c may determine whether the material of the sheet 2 can pass the light so that the solenoid 24 can be controlled by the control device b.

Figs. 3 to 5 show a second embodiment of the present invention. Since this second embodiment is the same as the above-mentioned first embodiment except for the construction of a sheet hold-down portion 26, only the difference will be exclusively explained.

A sheet hold-down plate 26 is fixedly mounted on a shaft 27 rotatably arranged on an axis same as that of the upper sheet ejector roller 12. Further, a torsion coil spring 29 is disposed around the shaft 27, which spring always biases the sheet hold-down plate 28 in a direction shown by the arrow A in Fig. 3. A gear 30 secured to an end of the shaft 27 is meshed with a gear 31. A pin 32 protruding from an end surface of the gear 31 can be engaged by a lever 33 arranged at a side of the gear 31 so that the gear 30 and the sheet hold-down plate 28 are held at a predetermined position. In this predetermined position, the sheet hold-down plate 28 is separated from the platen 11 and can be pivoted only in a direction shown by the arrow B in Fig. 3.

A roller (urging means) 34 rotatably mounted on the carriage 18 serves to urge the sheet hold-down plate 28 against the platen 11 by riding on the plate 28 when the carriage is shifted over the platen 11. Further, the sheet hold-down plate 28 is provided with an inclined end portion 35 for facilitating the riding of the roller 34 on the sheet hold-down plate.

Next, the operation of the recording apparatus having the above-mentioned construction according to this embodiment will be explained.

If the leading end of the sheet 2 fed on the platen 11 is curled upwardly as shown in Fig. 4, since the sheet hold-down plate 28 is separated from (i.e., open to) the platen 11, the curled leading end of the sheet can be directed below the sheet hold-down plate 28. And, when the sheet 2 is fed to the predetermined position as in the first embodiment, the carriage 18 which is waiting at the side of the platen 11 is now shifted along the rail 17, with the result that the roller 34 will ride on the sheet hold-down plate 28 while rolling. Consequently, as shown in Fig. 5, the leading end of the sheet 2 is urged against the platen 11 by the roller 34 via the sheet hold-down plate 28, thus providing the proper printing condition of the sheet. Thereafter, the printing lines are sequentially recorded on the sheet 2.

If a plastic sheet on which the ink is hard to be dried is used as the recording sheet, the lever 33 is rotated in a direction shown by the arrow C in Fig. 3 so that the sheet hold-down plate 28 is retarded to a position shown by a phantom line in Fig. 3 (i.e., a position where the sheet hold-down plate does not interfere with the scanning action of the carriage), thus preventing the contact between the sheet hold-down plate and the sheet.

Incidentally, in the illustrated embodiment, while the sheet hold-down plate could be pivoted, it

may be translated in an up-and-down direction.

Fig. 8 is an elevational sectional view of a recording apparatus according to a third embodiment of the present invention, and Fig. 9 is a perspective view of such recording apparatus.

As shown in Fig. 8, the recording apparatus is so designed that an uppermost sheet 102 picked up and separated from a sheet stack rested in a cassette 101 by means of a pick-up roller 103 is fed by a sheet feeding means 104, and printing lines are recorded on the sheet supported on a platen 105 by means of a recording head (recording means) 106 while the floating of the sheet 102 is being prevented by a sheet hold-down plate 107.

When a carriage 108 is shifted for the recording operation, the sheet hold-down plate 107 is urged against the recording sheet 102 by means of an urging member 109 attached to the carriage 108; whereas, when the carriage 108 returns to its home position, the sheet hold-down plate is separated from the recording sheet 102.

Next, various elements will be fully described.

The sheet feeding means 104 comprises feed roller 104a and pinch roller 104b for feeding the recording sheet 102 to a recording area, and ejector roller 104c and pinch roller 104d for ejecting the recorded sheet onto an ejection tray 110. The feed roller 104a and the ejector roller 104c are connected to and driven by respective feed motors (not shown), and the pinch rollers 104b, 104d are rotatably mounted on one ends of corresponding levers 104f pivotally mounted on corresponding shafts 104e and are urged against the feed roller 104a and the ejector roller 104c, respectively, by means of corresponding tension springs 104g attached to the other ends of the levers 104f. Accordingly, when the feed motors are activated, the recording sheet 2 is shifted in a direction shown by the arrow a in Fig. 8.

Incidentally, a driving force is transmitted to the ejector roller 104c via a slip clutch (not shown) so that a peripheral speed of the ejector roller becomes faster than that of the feed roller 104a by a few percents (%), thereby maintaining the proper tension in the recording sheet 102.

Next, the carriage will be explained.

The carriage 108 is slidably and rotatably mounted on a main scan rail 108a shown in Fig. 9 and can be reciprocably shifted along the main scan rail 108a in directions transverse to the width of the recording sheet 102.

A home position sensor is disposed at the home position of the carriage 108 to detect the fact that the carriage is in the home position. When the carriage is in the home position (Fig. 9), it is positioned out of the recording sheet 102.

Next, the sheet hold-down plate will be explained.

The sheet hold-down plate 107 serves to prevent the floating of the recording sheet 102 during the recording operation, and is arranged at a downstream side of a recording area P in the sheet feeding direction a. In the recording area, each printing line is recorded on the recording sheet 102 by shifting the recording head 106. Arm portions 107b are integrally formed on both ends of an urging portion 107a of the sheet hold-down plate 107 having a length longer than the width of the recording sheet 102 by bending the material of the sheet hold-down plate and are secured to a roller shaft 113 of the pinch roller 104d. Further, a torsion coil spring 114 is mounted around one end of the roller shaft 113 so that the sheet hold-down plate 107 is always biased toward a direction shown by the arrow b in Fig. 9.

A gear 115 secured to the shaft 113 is meshed with a gear 116. A pin 116a protruding from an end surface of the gear 116 can be engaged by a lever 117 arranged at a side of the gear 116 so that the gear 115 and the sheet hold-down plate 107 are held at a predetermined position. In this predetermined position, as shown in Fig. 10, the urging portion 107a of the sheet hold-down plate is separated from the platen 105.

Further, the urging portion 107a of the sheet hold-down plate is provided at its one end with an inclined end portion 107c for facilitating the riding of an urging roller 109 (described later) rotatably mounted on the carriage 108 on the urging portion 107a.

Further, a surface of the urging portion 107a which contacts with the sheet 102 has a "water repelling feature" in order to prevent the non-dried ink including paper powder and the like from adhering to the urging portion 107a. The "water repelling feature" herein is a feature that an angle of contact regarding the pure water is greater than 90 degrees. The greater the angle of contact, the more the non-dried ink is hard to adhere to the urging portion.

In the illustrated embodiment, the surface of the urging portion 107a which contacts with the sheet has a water repelling layer $107a_1$ formed by coating the water repelling agent on that surface to provide the "water repelling feature". In consideration of a contacting feature with the ink, the water repelling agent may preferably be, for example, PFA (tetrafluoro ethylene - perfluoro alkyl vinyl ether copolymer), FEP (tetrafluoroethylene - hexafluoro propylene copolymer), PTFE (polytetrafluoro ethylene) and the like from the fluorine group, or may preferably be, for example, silicon resin and the like from the silicon group. Further, the coating of the water repelling agent may be performed by using a spray coating tech-

nique, brush coating technique, dipping technique, roll coating technique or the like.

Next, the urging member will be explained.

The urging member serves to urge the urging portion 107a of the sheet hold-down plate against the platen 105. In the illustrated embodiment, the urging member comprises an urging roller 109 rotatably mounted on a lower surface of the carriage 108. When the carriage 108 is shifted in a direction shown by the arrow c in Fig. 9, the urging roller 109 rides on the urging portion 107a by the action of the weight of the carriage itself. As a result, the urging portion 107a of the sheet hold-down plate is rotated in opposition to the biasing force of the torsion coil spring 114, so that the sheet 102 is urged against the platen 105 by the urging portion 107a, as shown in Fig. 11. Thus, even if the recording sheet 102 is curled, a portion of the sheet 102 in the recording area is prevented from floating from the platen 105.

Incidentally, although a thickness of the recording sheet 102 to be fed is varied depending upon the kind of recording sheet, since the carriage 108 can be pivoted around the main scan rail 108a and can ride on the sheet hold-down plate 107, a distance between the recording sheet 102 and the recording head 106 is always maintained at a constant value, regardless of the thickness of the recording sheet 102.

With the arrangement as mentioned above, since the carriage 108 is in the home position during the feeding of the sheet, as shown in Fig. 10, the sheet hold-down plate 107 is separated from the platen 105. Consequently, even if the leading end of the recording sheet 102 is curled more or less, it can be easily introduced below the urging portion 107a of the sheet hold-down plate. When the recording sheet 102 is fed up to the predetermined position, the carriage 108 which is waiting at the side of the platen 105 is now shifted along the main scan rail 108a, with the result that, as shown in Fig. 11, since the recording sheet 102 is urged against the platen 105 by the urging portion 107a, the leading end of the recording sheet 102 is prevented from floating from the platen even if the leading end of the recording sheet is not pinched by the ejector roller 104c and the pinch roller 104d, thus providing the proper printing condition of the sheet.

Further, when the recording sheet 102 is urged against the platen 105 by means of the urging portion 107a, since the sheet contacting surface of the urging portion has the water repelling feature, the paper powder and the like remaining on the recording sheet 102 does not adhere to the urging portion, and, even if the ink discharged on the sheet 102 is not completely dried, the ink does not adhere to the sheet hold-down plate 107. Thus, even when the sheet hold-down plate 107 contacts with the recording surface of the recording sheet 102, the sheet is not smeared with the ink.

Incidentally, a sheet such as a plastic sheet (OHP sheet) on which the ink is hard to be dried is used as the recording sheet 102, the lever 117 is rotated in a direction shown by the arrow d in Fig. 9, with the result that the sheet hold-down plate 107 is retarded to a position shown by a phantom line in Fig. 9 (i.e., a position where the sheet hold-down plate does not interfere with the shifting movement of the carriage 108) by the spring force of the torsion coil spring 114. Thus, since the recorded sheet 102 does not contact with the sheet hold-down plate 107 as shown in Fig. 12, the sheet and the sheet hold-down plate are not smeared with the ink.

Next, a fourth embodiment of the present invention will be explained. Incidentally, constructural elements same as those in the aforementioned third embodiment are designated by the same reference numerals, and the explanation thereof will be omitted.

While the sheet hold-down plate 107 was arranged only at the downstream side of the recording area in the third embodiment, in this fourth embodiment, an additional sheet hold-down plate may be disposed at an upstream side of the recording area.

For example, as shown in Figs. 13 and 14, in addition to the aforementioned sheet hold-down plate 107, an additional sheet hold-down plate 118 is disposed at the upstream side of the sheet hold-down plate 107 in the sheet feeding direction. The upstream sheet hold-down plate 118 is provided with arm portion 118b integrally formed on both ends of an urging portion 118a of the sheet hold-down plate 118 having a length longer than the width of the recording sheet 102 by bending the material of the sheet hold-down plate. The arm portion 118b are rotatably supported by a roller shaft 119 of the pinch roller 104b. Further, a tension spring 120 attached to one end of one of the arm portion 118b biases the urging portion 118a of the sheet hold-down plate toward a direction shown by the arrow e in Fig. 14, so that the arm portions 118b are abutted against a shaft 104e acting as a stopper. Incidentally, in a condition that the arm portions 118b are abutted against the shaft 104e, the urging portion 118a is separated from the platen 105 (Fig. 15).

Further, the urging portion 118a of the sheet hold-down plate is provided at its one end with an inclined end portion 118c for facilitating the riding of an upstream urging roller 121 acting as an urging member rotatably mounted on the carriage 108 on the urging portion 118a.

With the arrangement as mentioned above,

when the carriage 108 is shifted for the recording operation, the urging rollers 109, 121 urge the sheet hold-down plates 107, 118 downwardly, respectively, with the result that the recording sheet 102 is urged against the platen 105 by means of the sheet hold-down plates 107, 118, respectively, at downstream and upstream sides of the recording area. Accordingly, if a trailing end of the recording sheet is curled, even when the trailing end of the recording sheet leaves the feed roller 104a and pinch roller 104b, the floating of the trailing end of the recording sheet can effectively be prevented, thus providing the stable recording condition of the sheet.

Incidentally, when the sheet hold-down plates 107, 118 are provided, as shown in Fig. 16, a thickness t_1 of the upstream sheet urging portion 118a is so selected as to be thinner than a thickness t_2 of the downstream sheet urging portion 107a ($t_1 < t_2$), and a distance between the platen 105 and the upstream urging roller 121 is preferably selected to be shorter than a distance between the platen and the downstream urging roller 109.

For example, the thickness t_1 of the upstream sheet urging portion 118a was 0.25 mm and the thickness t_2 of the downstream sheet urging portion 107a was 0.5 mm. Further, in the condition that the recording sheet 102 is urged against the platen by means of the sheet urging portions 118a, 107a as shown in Fig. 16, a distance ℓ between the recording sheet 102 and the recording head 106 was set to have a value of 0.7 mm.

With this arrangement, when the downstream sheet hold-down plate 107 is retarded to the position shown in Fig. 17 by manipulating the lever 117, the recording sheet 102 can surely be prevented from contacting the downstream urging roller 109.

Incidentally, when the distance between the downstream urging roller 109 and the platen 105 is longer than the distance between the upstream urging roller 121 and the platen as mentioned above, in order to compensate for the difference in such distances, in place of the above-mentioned construction, as shown in Fig. 18, the thickness of the downstream sheet urging portion 107a may be the same as that of the upward sheet urging portion 118a and a spacer sheet 122 may be adhered to an upper surface of the downstream sheet urging portion 107a to compensate for such difference.

Alternatively, in place of the spacer sheet 122, as shown in Fig. 19, the downstream sheet hold-down plate 107 may be formed to have a stepped configuration so that the difference between the longer distance (between the downstream urging roller 109 and the platen 105) and the shorter distance (between the upstream urging roller 121 and the platen) can be compensated.

Further, in the illustrated embodiment, while the sheet hold-down plates could be pivoted, they may be translated in up-and-down directions. In addition, while the sheet hold-down plates were urged or shifted by the movement of the carriage 108, they may be connected to respective plungers so that they can be urged against the platen by activating the plungers on the basis of a signal from a control portion.

Further, in all of the illustrated embodiments, a bubble jet recording system can be used as the recording means.

Next, the recording means used with each embodiment of the present invention will be described.

The recording means serves to form an ink image on the recording sheet fed by the feeding means. In one embodiment, the recording means utilizes an ink jet recording system.

The ink jet recording system includes liquid discharge openings for discharging recording ink as flying liquid droplets, liquid passages communicated with the discharge openings, and discharge energy generating means provided at portions of the liquid passages and adapted to generate discharge energy for flying the ink liquid in the liquid passages. By activating the selected energy generating means in response to a drive signal, the ink droplets are discharged from the discharge openings to form an image on a recording sheet.

The discharge energy generating means may be, for example, a pressure energy generating means using electrical/mechanical converter elements such as piezo electric elements, an electromagnetic energy generating means for discharging the ink by applying the electromagnetic wave such as laser to the ink liquid so as to heat the ink liquid, or a thermal energy generating means for discharging the ink liquid by heating the ink liquid by means of electrical/thermal converter elements. Among them, the thermal energy generating means using electrical/thermal converter elements is most preferable since the discharge openings can be arranged with high density to perform the recording with high resolving power and the recording head can be compacted.

In the illustrated embodiment, a bubble jet recording means which is one kind of the ink jet recording means is used as the recording means.

Fig. 20 shows an exploded perspective view of the recording head 6, 106 constituting the recording means, and Figs. 21A to 21G show a principle of the bubble jet recording process.

In Fig. 20, the reference numeral 206a denotes a heater board wherein electrical/thermal converters (discharge heaters) 206b and electrodes 206c made of aluminum which supply electric powers to

the electrical/thermal converters are formed on a silicon substrate by a film forming process. A top plate 206e having partition walls for defining recording liquid passages (nozzles) 206d is adhered to the heater board 206a. Further, an ink cartridge (not shown) for supplying the ink to the recording head is removably mounted on the head in place.

The ink supplied from the ink cartridge to the recording head via a conduit is directed to a common liquid chamber 206g in the head through a supply opening 206f formed on the top plate 206e and then is sent to the nozzles 206d from the common liquid chamber 206g. The nozzles 206d have ink discharge openings 206h, respectively, which are disposed at a predetermined pitch along a sheet feeding direction in downward confronting relation to the sheet.

In the illustrated embodiment, the recording head 6, 106 is mounted on a reciprocable carriage and the recording is performed by discharging the ink from the recording head 6, 106 in synchronous with the shifting movement of the carriage.

Preferably, a principle for forming the flying ink droplet in the bubble jet recording system can be realized by using the fundamental principles, for example, disclosed in U.S. Patent Nos. 4,723,129 and 4,740,796. Although this system can be applied to both a so-called "on-demand type" and "continuous type", it is more effective when the system is particularly applied to the on-demand type, because, by applying at least one drive signal corresponding to the record information and capable of providing the abrupt temperature increase exceeding the nucleate boiling to the electrical/thermal converting elements arranged in correspondence to the sheet or liquid passages including the liquid (ink) therein, it is possible to form a bubble in the ink in corresponding to the drive signal by generating the film boiling on the heat acting surface of the recording head due to the generation of the thermal energy in the electrical/thermal converting elements. Due to the growth and contraction of the bubble, the ink is discharged from the discharge opening to form at least one ink droplet. When the drive signal has a pulse shape, since the growth and contraction of the bubble can be quickly effected, more excellent ink discharge is achieved.

Now, the principle for forming the flying droplet in the bubble jet recording process will be briefly explained with reference to Figs. 21A to 21G.

In the steady-state, as shown in Fig. 21A, a tension force of the ink 211 filled in the nozzle 206d is equilibrated with the external force at an discharge opening surface. In this condition, when the ink 211 is desired to fly, the electrical/thermal converter 206b disposed in the nozzle 206d is energized to abruptly increase the temperature of the ink in the nozzle 206d exceeding the nucleate boiling. Consequently, as shown in Fig. 21B, the ink portion adjacent to the electrical/thermal converter 206b is heated to create a fine bubble, and then the heated ink portion is vaporized to generate the film boiling, thus growing the bubble 212 quickly, as shown in Fig. 21C.

When the bubble 212 is grown at the maximum extent as shown in Fig. 21D, the ink droplet is pushed out of the discharge opening of the nozzle 206d. When the electrical/thermal converter 206b is disenergized, as shown in Fig. 21E, the grown bubble 212 is cooled by the ink 211 in the nozzle 206d to contract. Thus, the growth and contraction of the bubble, the ink droplet is flying from the discharge opening. Further, as shown in Fig. 21F, the ink contacted with the surface of the electrical/thermal converter 206b is quickly cooled, thus diminishing the bubble 212 or reduce the volume of the bubble to the negligible extent. When the bubble 212 is diminished, as shown in Fig. 21G, the ink is replenished in the nozzle 206d from the common liquid chamber 206g by a capillary phenomenon, thus preparing the next formation of the ink droplet.

Accordingly, by reciprocally shifting the carriage and by selectively energizing the electrical/thermal converters 206b in response to the pulse drive signal, the ink image can be recorded on the sheet. Preferably, the pulse drive signal may be ones disclosed in U.S. Patent Nos. 4,463,359 and 4,354,262. Further, when the condition discussed in the U.S. Patent No. 4,313,124 relating to the invention regarding the increasing rate of the temperature of the heat acting surface, more excellent recording can be achieved.

Incidentally, in the above-mentioned recording system, it is preferable that a recovery means and an auxiliary aiding means are provided at the home position of the carriage. More particularly, these means include a capping means for capping the recording head, cleaning means, pressurizing or suction means, auxiliary heating means comprising electrical/thermal converters 206b or other heating elements or the combination thereof, and a preliminary discharge mode means for discharging the ink independently of the recording operation.

As the construction of the recording head, the present invention includes the construction wherein the head acting portion is disposed in an arcuate area as disclosed in U.S. Patent Nos. 4,558,333 and 4,459,600, as well as the aforementioned constructions wherein the discharge openings, liquid paths and electrical/thermal converting elements are combined (straight liquid paths or orthogonal liquid paths). In addition, the present invention can applicable to the construction wherein each discharge opening is constituted by a slit with which a

plurality of electrical/thermal converting elements associated in common as disclosed in the Japanese Patent Laid-Open No. 59-123670 or the construction wherein openings for absorbing the pressure wave of the thermal energy are arranged in correspondence to the discharge openings as disclosed in the Japanese Patent Laid-Open No. 59-138461, because the recording can be correctly and effectively performed by the bubble jet recording system, regardless of the configuration of the recording head.

Further, the present invention can be applied to a recording head of full-line type having a length corresponding to a maximum width of a recording medium to be recorded, as such recording head, the construction wherein such length is attained by combining a plurality of recording heads or a single recording head integrally formed may be adopted.

In addition, among the above-mentioned serial types, the present invention is effectively applicable to a removable recording head of chip type wherein, when mounted on the recording system, electrical connection between it and the recording system and the supply of ink from the recording system can be permitted, or to a recording head of cartridge type wherein a cartridge is integrally formed with the head.

Further, as to the kind and number of the recording head to be mounted, each recording head may correspond to each different color ink, or a plurality of recording heads can be used for a plurality of ink having different colors and/or different density. Further, as the recording mode of the recording system, the present invention can effectively be applied not only to a recording mode with a single main color such as black, but also to a system providing a plurality of different colors and/or a full-color by mixing colors by using an integrated recording head or the combination of plural recording heads.

Further, in the illustrated embodiments, while the ink was liquid, the ink may be solid in a room temperature or less, or may be softened at a room temperature. In the above-mentioned ink jet recording system, since the temperature control is generally effected in a temperature range from 30°C to 70°C so that the viscosity of the ink is maintained within a stable discharging range, the ink may be liquidized when the record signal is omitted. In addition, ink having a feature that is firstly liquidized by the thermal energy, such as solid ink which serves to prevent the increase in temperature by absorbing energy in charging the ink from the solid state to the liquid state or which is in the solid state in the preserved condition to prevent the vaporization of ink and which is liquidized into ink liquid to be discharged in response to the record signal comprising the thermal energy, or ink which has already been solidified upon reaching the recording medium, can also be applied to the present invention. In such a case, the ink can be held in the liquid state or solid state in recesses or holes in porous sheet as disclosed in the Japanese Patent Laid-Open Nos. 54-56847 and 60-71260, in confronting relation to the electrical/thermal converters. Incidentally, in the bubble jet recording, the above-mentioned film boiling principle is most effective for each ink.

Further, in the illustrated embodiments, while the ink jet recording system was explained as the recording means, other recording means such as a wire dot recording system and the like may be used as the recording means.

In addition, the feeding means for the recording sheet is not limited to the rollers as in the illustrated embodiments, but, for example, the feeding force may be applied to the recording sheet 102 by means of a rotatable belt and the like.

Incidentally, the recording apparatus can be in the form of a copying machine in combination with a reader or a facsimile system having the communication function, as well as an image terminal equipment for an information treating device such as a computer and the like.

As mentioned above, since the leading end of the recording sheet is urged against the platen by means of the sheet hold-down plate during the recording operation, it is possible to prevent the floating of the recording sheet and to minimize the blank portion remaining at the leading portion of the recording sheet, thus providing the excellent recording efficiency.

Further, since the sheet contacting surface of the sheet hold-down plate has the water repelling feature, it is hard to adhere the ink and the like to the sheet hold-down plate, thus effectively preventing the recording sheet from being smeared with the ink. Particularly, it is true when a sheet (for example, OHP sheet) on which the ink is hard to be dried is used.

In the illustrated embodiments, the recording sheet can be manually supplied one by one. Such manual sheet supply will be explained in connection with the above-mentioned fourth embodiment, for example.

In Fig. 13, the reference numeral 131 denotes a switch for changing to a manual sheet supply mode; and 130 denotes a control circuit. When the manual sheet supply mode is established by the switch 131, a manual sheet supply guide 110a is shifted, by means of a plunger 110b, from a position where it is aligned with the ejection tray 110 to a position shown by the phantom line in Fig. 13. In this condition, when the recording sheet is rested on the ejection tray 110 and then is slid toward the ejector roller 104c, the leading end of the recording

sheet is directed, by the manual sheet supply guide 110a, to the nip between ejector roller 104c and the pinch roller 104d. When the recording sheet reaches the nip, the leading end of the recording sheet is detected by a sensor 110c, with the result that, in response to a detection signal from the sensor, the control circuit 130 activates the motor to rotate the feed roller 104a and the ejector roller 104c in a clockwise (reverse) direction.

The recording sheet is conveyed on the platen 105 while being pinched by the ejector roller 104c and the pinch roller 104d. In this point, since the carriage 108 is in the home position, as shown in Fig. 15, the downstream and upstream sheet hold-down plates 107, 118 are separated from the platen 105, thus not blocking the movement of the recording sheet. Then, the leading end of the sheet is pinched by the feed roller 104a and the pinch roller 104b and is fed between the pick-up roller 103 and the uppermost sheet in the cassette 101.

When the trailing end of the recording sheet reaches a predetermined position between the ejector roller 104c and the feed roller 104a, the recording sheet is stopped temporarily. The predetermined position may be a position shown in Fig. 15 or may be any position at the upstream side of the position of Fig. 15 so long as the recording sheet is pinched by the feed roller 104a and the pinch roller 104b. In order to stop the recording sheet at the predetermined position, the control circuit 130 counts the time or the pulse numbers of the motor for driving the roller 104c immediately after the trailing end of the recording sheet has just passed through the roller 104c, and stops the roller when predetermined pulse numbers are counted.

Then, the feed roller 104a is rotated in an anti-clockwise (normal) direction by predetermined pulse numbers in order to feed the recording sheet up to the position of Fig. 15. If the recording sheet is firstly stopped at this position, the normal rotation of the feed roller is not needed. Thereafter, the recording operation is performed in the same manner as in the case where the recording sheet is supplied from the cassette 101 as mentioned above. After the recording is finished, the recording sheet is ejected on the ejection tray 110.

In the above-mentioned embodiments, the platen 105 supports the recording sheet at the recording area by contacting the back surface (opposite to the recording head) of the recording sheet. However, alternatively, the platen may be so designed that it supports the recording sheet by contacting the back surface of the recording sheet only at the downstream side or at both upstream and downstream sides of the recording area without contacting the back surface of the sheet at the recording area (i.e., the platen may be cut off at the recording area P shown in Fig. 8).

A recording apparatus comprising a platen for supporting a sheet at a recording area, feeding means for feeding the sheet to the platen, recording means for recording an image on the sheet at the recording area, and an urging member disposed at a downstream side of the recording area and adapted to urge the sheet against the platen.

Claims

1. A recording apparatus, comprising:
   a platen for supporting a sheet at a recording area;
   feeding means for feeding the sheet to said platen;
   recording means for recording an image on the sheet at said recording area; and
   an urging member disposed at a downstream side of said recording area and adapted to urge the sheet against said platen.

2. A recording apparatus according to claim 1, further including shifting means for shifting said urging member between an urging position where the sheet is urged against said platen and a non-urging position where the sheet is not urged against said platen.

3. A recording apparatus according to claim 2, further including operation means for activating said shifting means.

4. A recording apparatus according to claim 2, further including control means for controlling said shifting means in such a manner that said urging means is positioned either at said urging position or at said non-urging position during a recording operation.

5. A recording apparatus according to claim 4, further including a switch, and wherein said control means performs the control in accordance with the operation of said switch.

6. A recording apparatus according to claim 4, further including detection means for detecting the material of the sheet to be fed, and wherein said control means performs the control in accordance with a detection signal from said detection means.

7. A recording apparatus according to claim 1, wherein said feeding means is stopped whenever the sheet is fed by a predetermined distance, said recording means records the image on the sheet being stopped, and said urging

member is positioned at an urging position where the sheet is urged against said platen during the recording operation and is positioned at a non-urging position where the sheet is not urged against said platen during the feeding of the sheet.

8. A recording apparatus according to claim 1, wherein said recording means performs the recording operation while shifting in a direction transverse to a width of the sheet whenever the sheet is fed by a predetermined distance, and said urging member is shifted, in synchronous with the shifting of said recording means, from a non-urging position where the sheet is not urged against said platen to an urging position where the sheet is urged against said platen.

9. A recording apparatus according to claim 8, further including contacting means movable integrally with said recording means and adapted to shift said urging member to said urging position by contacting said urging member.

10. A recording apparatus according to claim 9, wherein said contacting means comprises a rotary body contacting said urging member while rolling.

11. A recording apparatus according to claim 1, further including control means for stopping said feeding means after said feeding means feeds the sheet to a predetermined position where a leading end of the sheet can be urged by said urging member, and for controlling to cause said urging member to urge the leading end of the sheet.

12. A recording apparatus according to claim 1, wherein said platen contacts the sheet at a downstream side of said recording area.

13. A recording apparatus according to claim 12, wherein said platen does not contact the sheet at said recording area.

14. A recording apparatus according to claim 1, wherein said recording means comprises an ink jet head for discharging ink.

15. A recording apparatus according to claim 14, wherein said ink jet head records the image on the sheet with the ink discharged by thermal energy.

16. A recording apparatus according to claim 1, wherein said urging member has a surface capable of contacting the sheet, said surface having a water repelling feature.

17. A recording apparatus according to claim 1, further including second urging member for urging the sheet against said platen between said feeding means and said recording area.

18. A recording apparatus according to claim 17, wherein said recording means performs the recording operation while shifting in a direction transverse to a width of the sheet whenever the sheet is fed by a predetermined distance, and said first and second urging members are shifted, in synchronous with the shifting of said recording means, from a non-urging position where the sheet is not urged against said platen to an urging position where the sheet is urged against said platen.

19. A recording apparatus according to claim 18, further including contacting means movable integrally with said recording means and adapted to shift said first and second urging members to said urging position by contacting said urging members.

20. A recording apparatus according to claim 19, wherein said contacting means comprises first and second rotary bodies contacting said first and second urging members while rolling, respectively.

21. A recording apparatus according to claim 20, wherein thickness of said first urging member in a direction substantially perpendicular to said platen is thinner than that of said second urging member in the direction substantially perpendicular to said platen.

22. A recording apparatus according to claim 17, wherein each of said first and second urging members has a plate shape.

23. A recording apparatus according to claim 1, wherein said urging member has a plate shape.

24. A recording apparatus comprising:

a platen for holding a sheet at a recording area;

first feeding means disposed at an upstream side of said platen and adapted to feed the sheet to said platen;

recording means for recording an image on the sheet at said recording area;

second feeding means disposed at a downstream side of said platen and adapted to

feed the sheet on which the image was recorded by said recording means; and

urging member disposed betweeen said recording area and said second feeding means and adapted to urge the sheet against said platen.

25. A recording apparatus according to claim 24, further including shifting means for shifting said urging member between an urging position where the sheet is urged against said platen and a non-urging position where the sheet is not urged against said platen.

26. A recording apparatus according to claim 25, further including operation means for activating said shifting means.

27. A recording apparatus according to claim 24, further including control means for controlling said shifting means in such a manner that said urging means is positioned either at the urging position or at the non-urging position during a recording operation.

28. A recording apparatus according to claim 27, further including a switch, and wherein said control means performs the control in accordance with the operation of said switch.

29. A recording apparatus according to claim 27, further including detection means for detecting the material of the sheet to be fed, and wherein said control means performs the control in accordance with a detection signal from said detection means.

30. A recording apparatus according to claim 24, wherein said recording means performs the recording operation while shifting in a direction transverse to a width of the sheet whenever the sheet is fed by a predetermined distance, and, in synchronous with the shifting of said recording means, said shifting means shifts said urging member to an urging position where the sheet is urged against said platen.

31. A recording apparatus according to claim 24, wherein said recording means comprises an ink jet head for discharging ink.

32. A recording apparatus according to claim 31, wherein said ink jet head records the image on the sheet with the ink discharged by thermal energy.

33. A recording apparatus according to claim 24, wherein said urging member has a surface capable of contacting the sheet, said surface having a water repelling feature.

34. A recording apparatus according to claim 24, further including second urging member for urging the sheet against said platen between said feeding means and said recording area.

35. A recording apparatus according to claim 24, further including an abutment means movable integrally with said recording means and adapted to shift said urging member to said urging position by contacting said urging member.

36. A recording apparatus according to claim 35, wherein said abutment means comprises a rotary body contacting said urging member while rolling.

37. A recording apparatus according to claim 24, further including guide means disposed at a downstream side of said second feeding means and adapted to guide the sheet to said second feeding means from the downstream side thereof; and control means for controlling to cause said second feeding means to feed the sheet guided by said guide means to said recording area and then to feed the sheet toward the downstream side.

38. A recording apparatus according to claim 37, wherein said control means controls said first feeding means to feed the sheet guided by said guide means and fed to said recording area by said second feeding means, toward the upstream side.

39. A recording apparatus according to claim 38, wherein said control means controls said first feeding means and said recording means to feed the sheet fed toward the upstream side by said first feeding means to said recording area by feeding the sheet toward the downstream side, and to record the image, by said recording means, on the sheet fed to said recording area.

FIG. 1

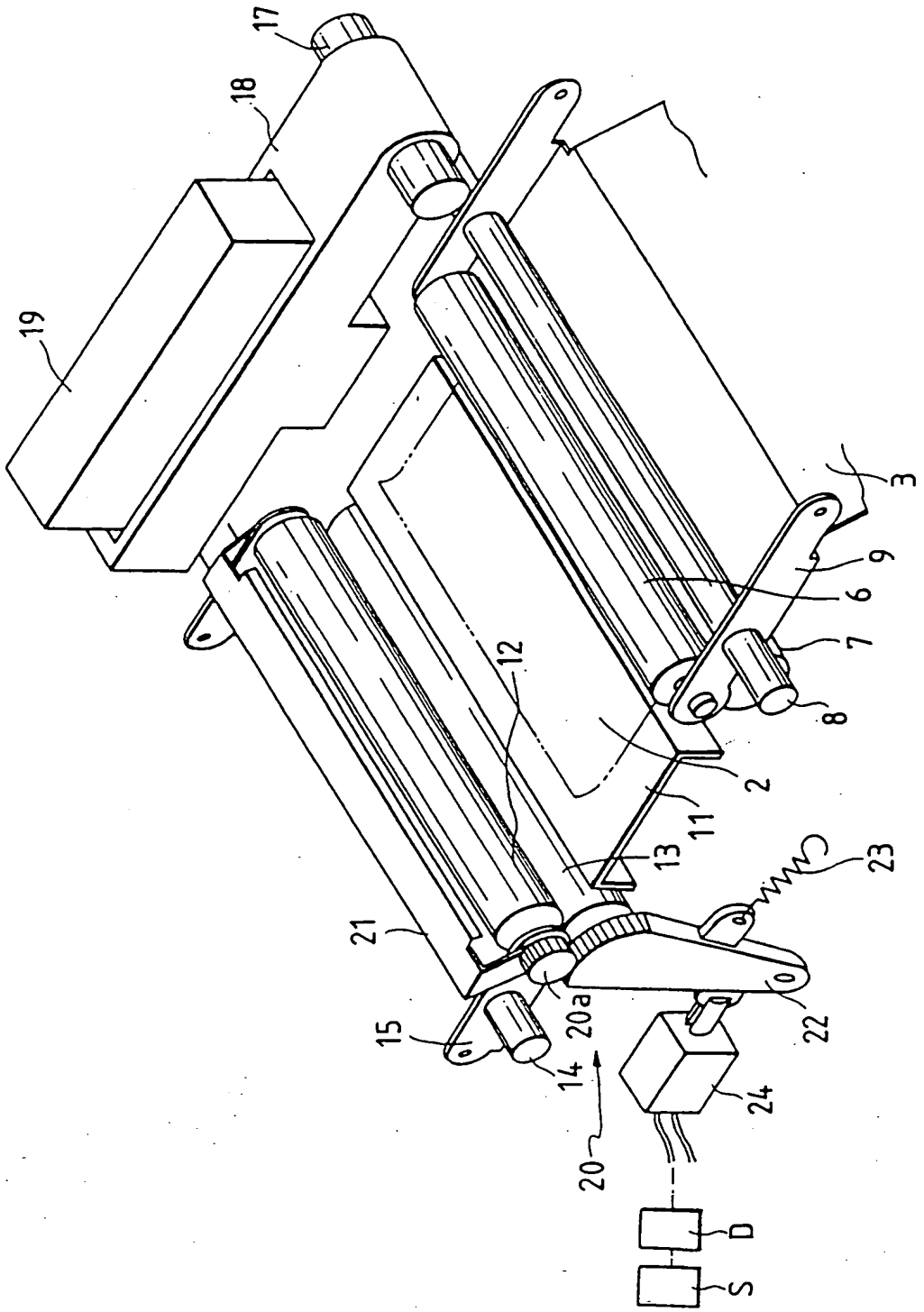


FIG. 2

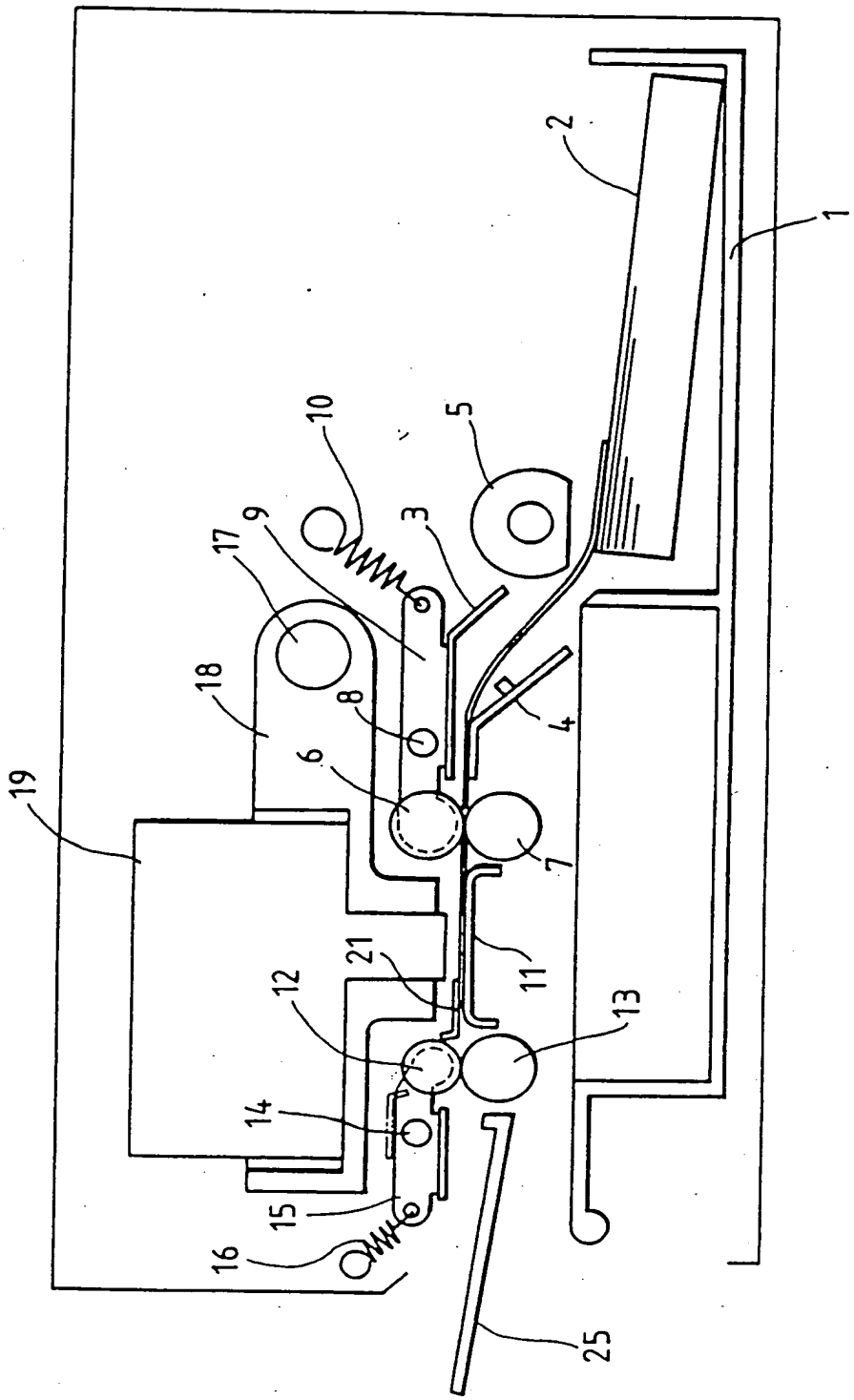


FIG. 3

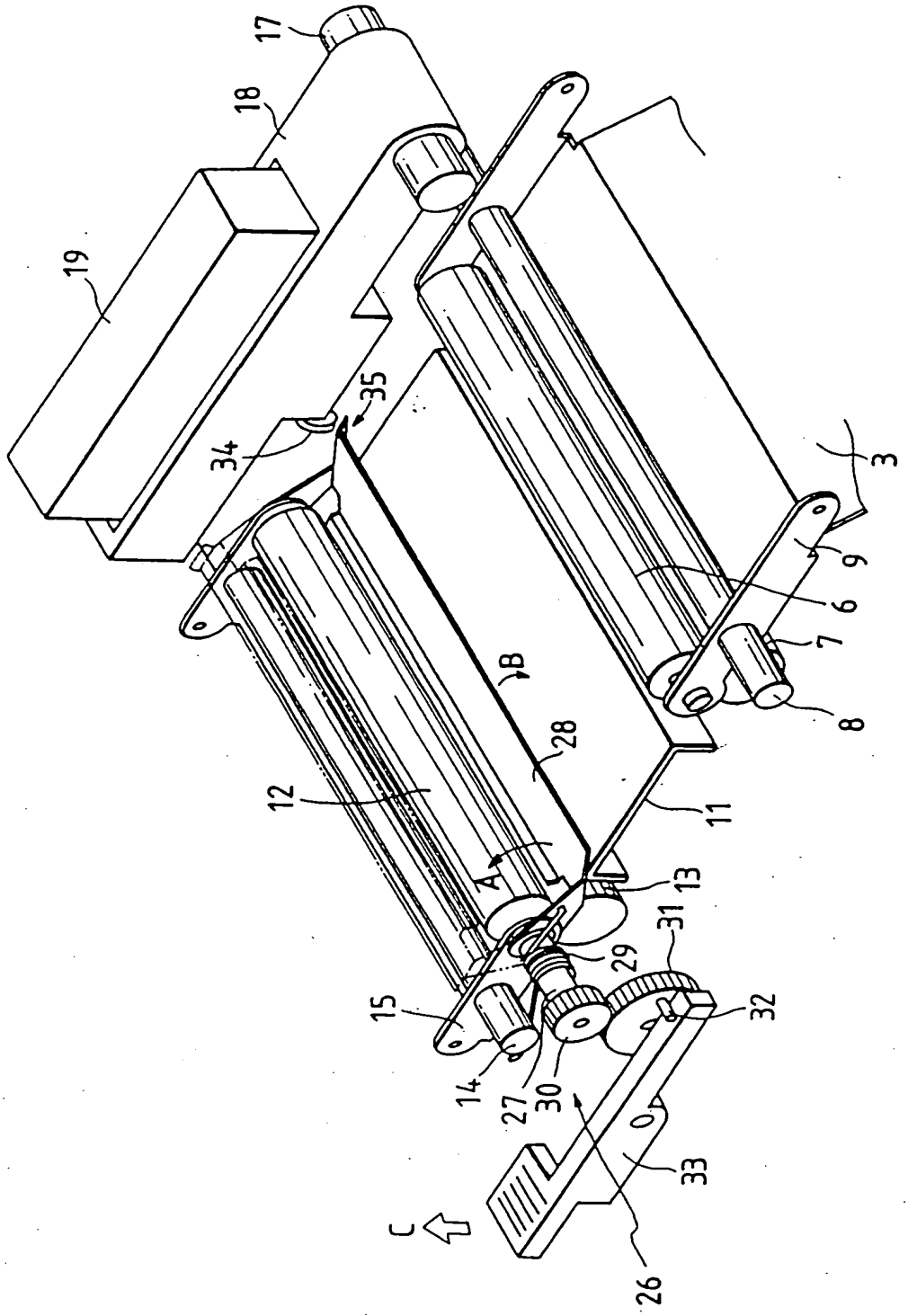


FIG. 4

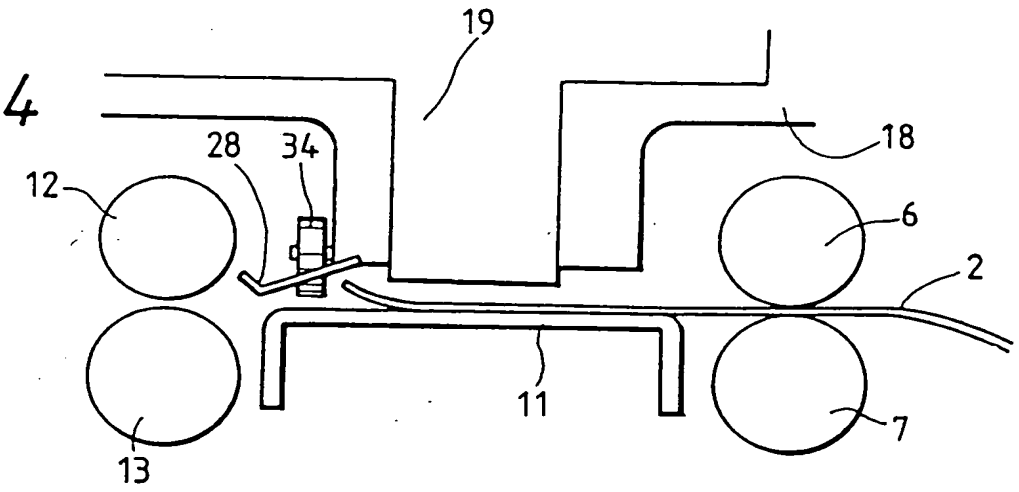


FIG. 5

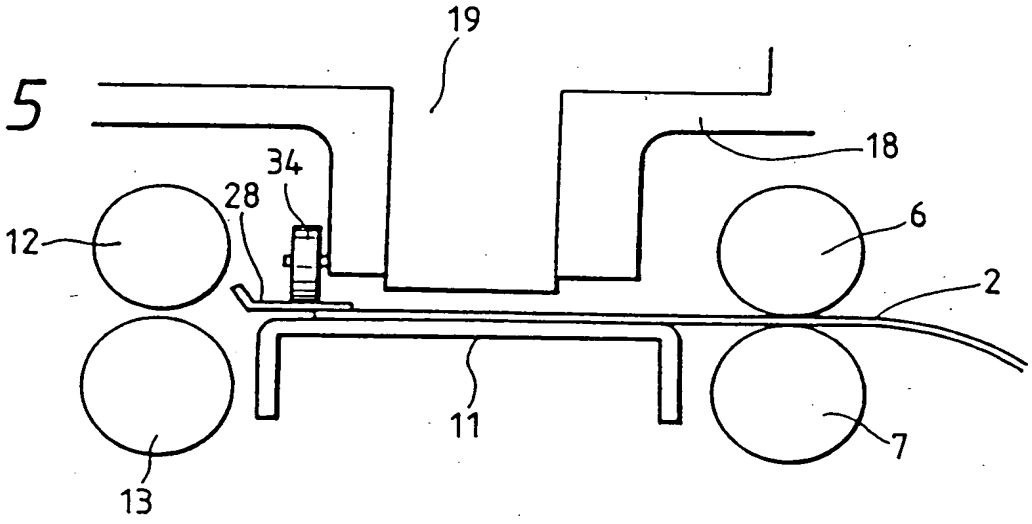


FIG. 6

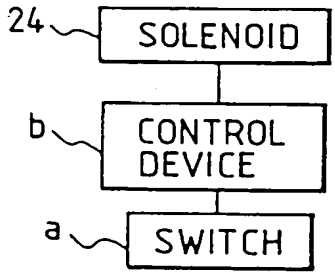


FIG. 7

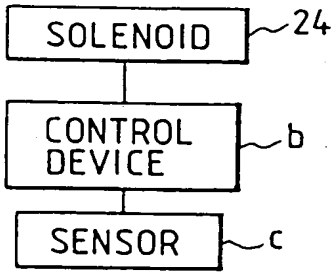
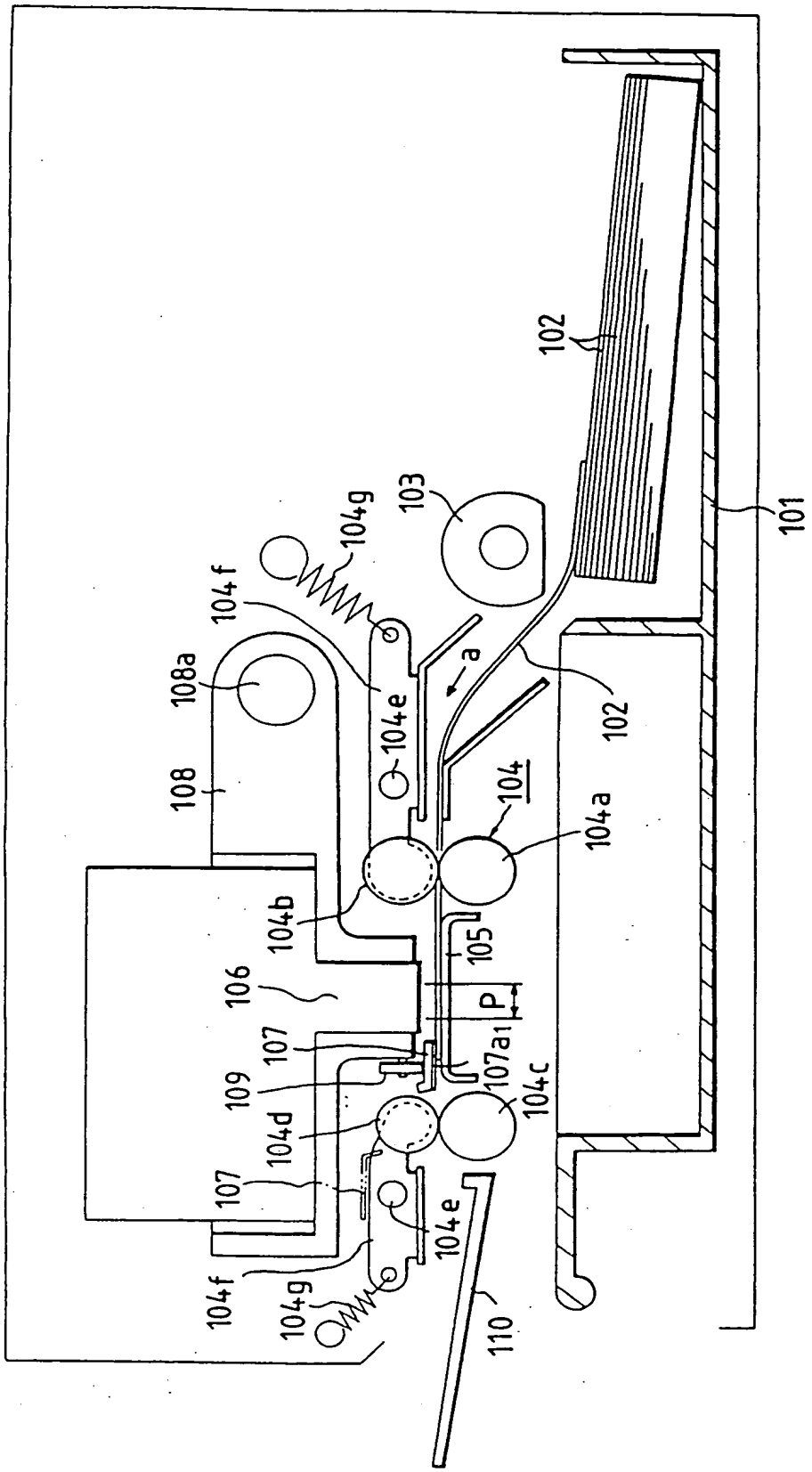


FIG. 8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104g
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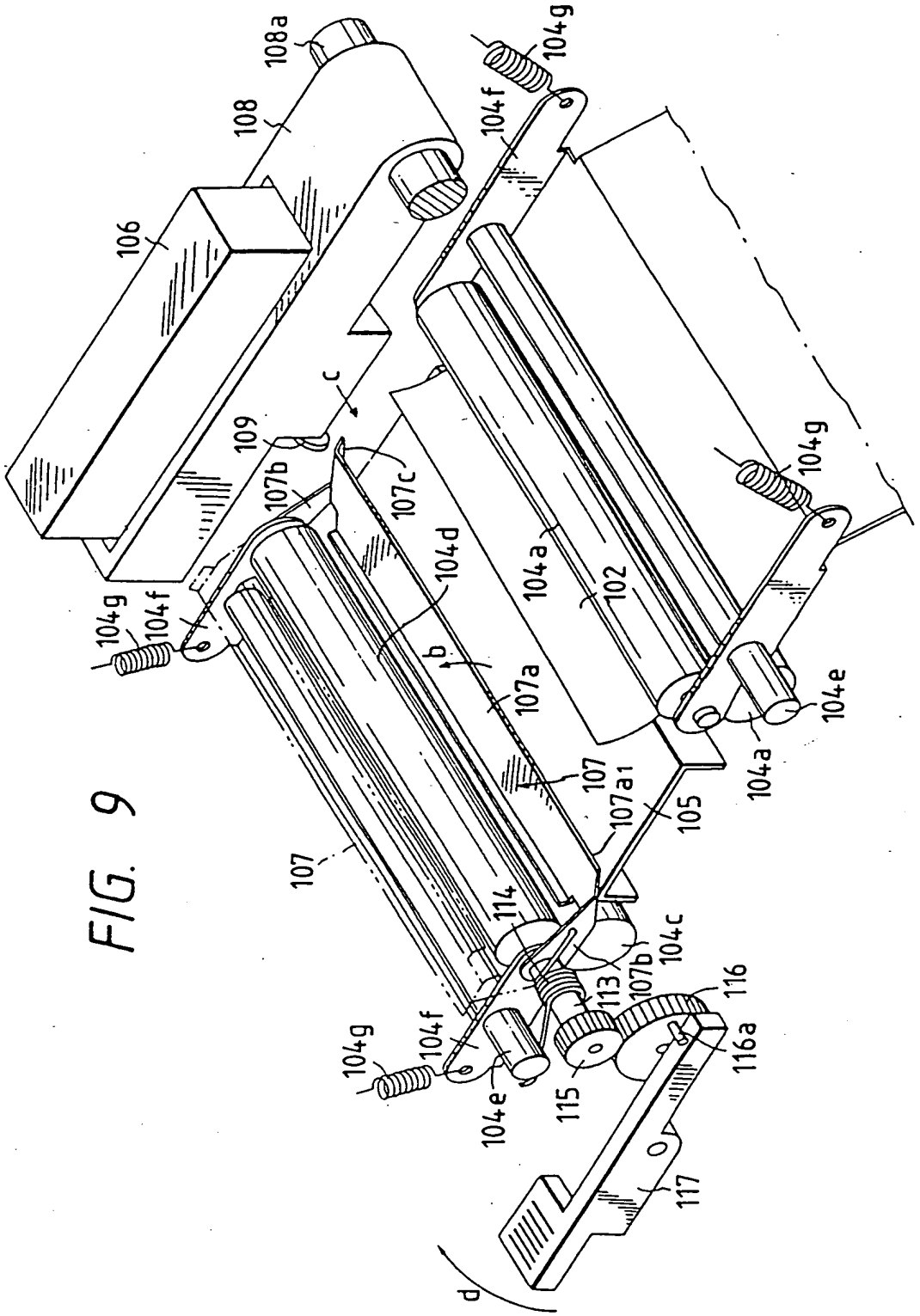
FIG. 9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d

FIG. 10

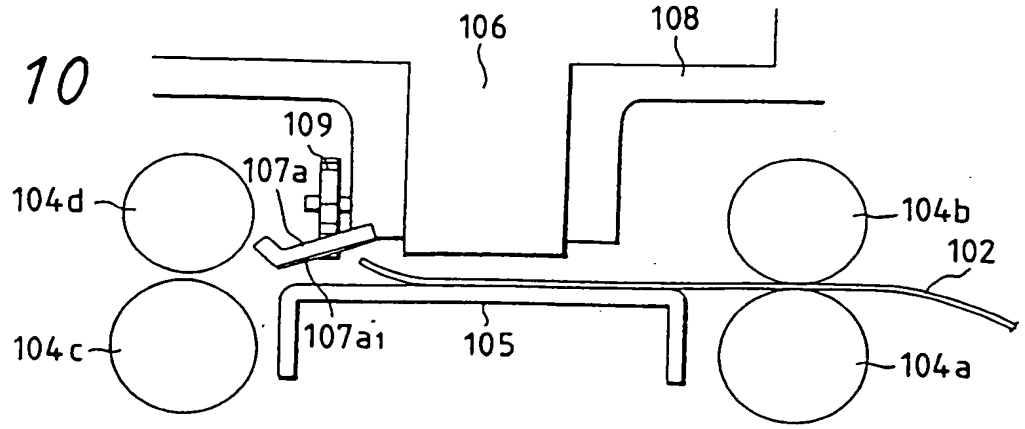


FIG. 11

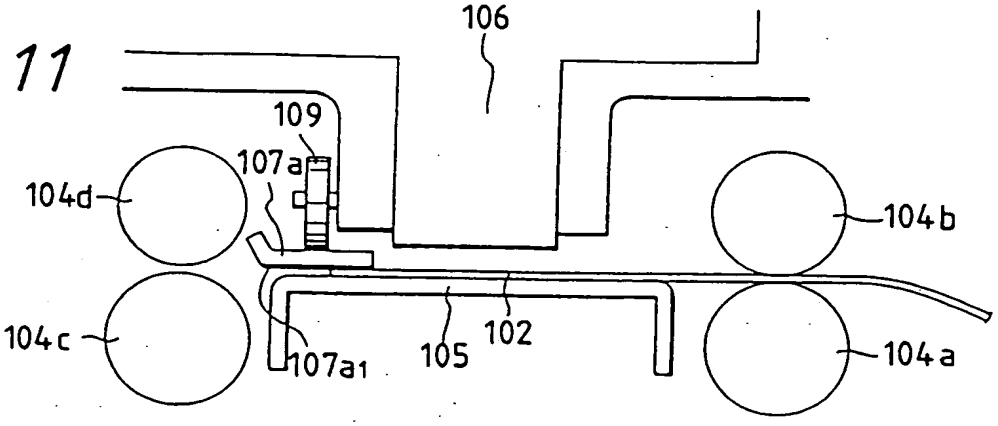


FIG. 12

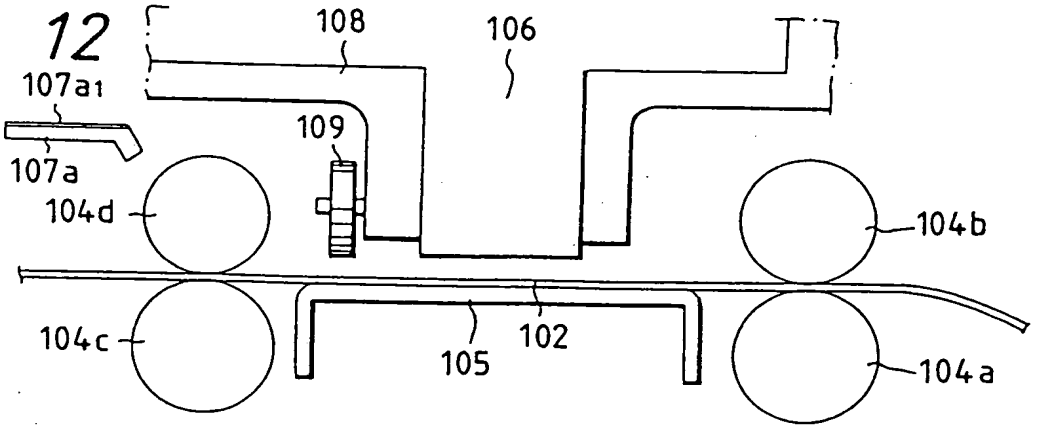
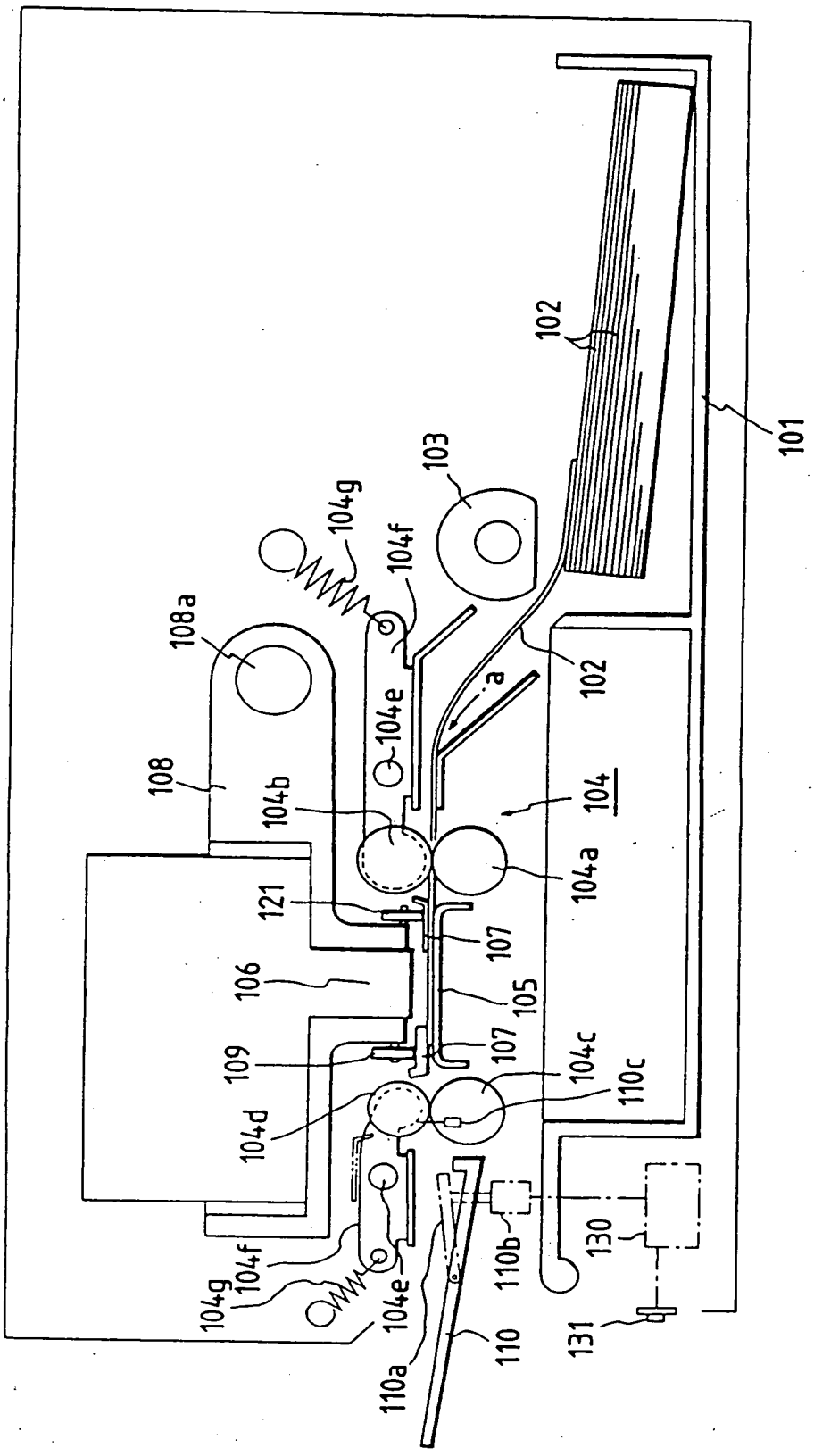


FIG. 13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104g
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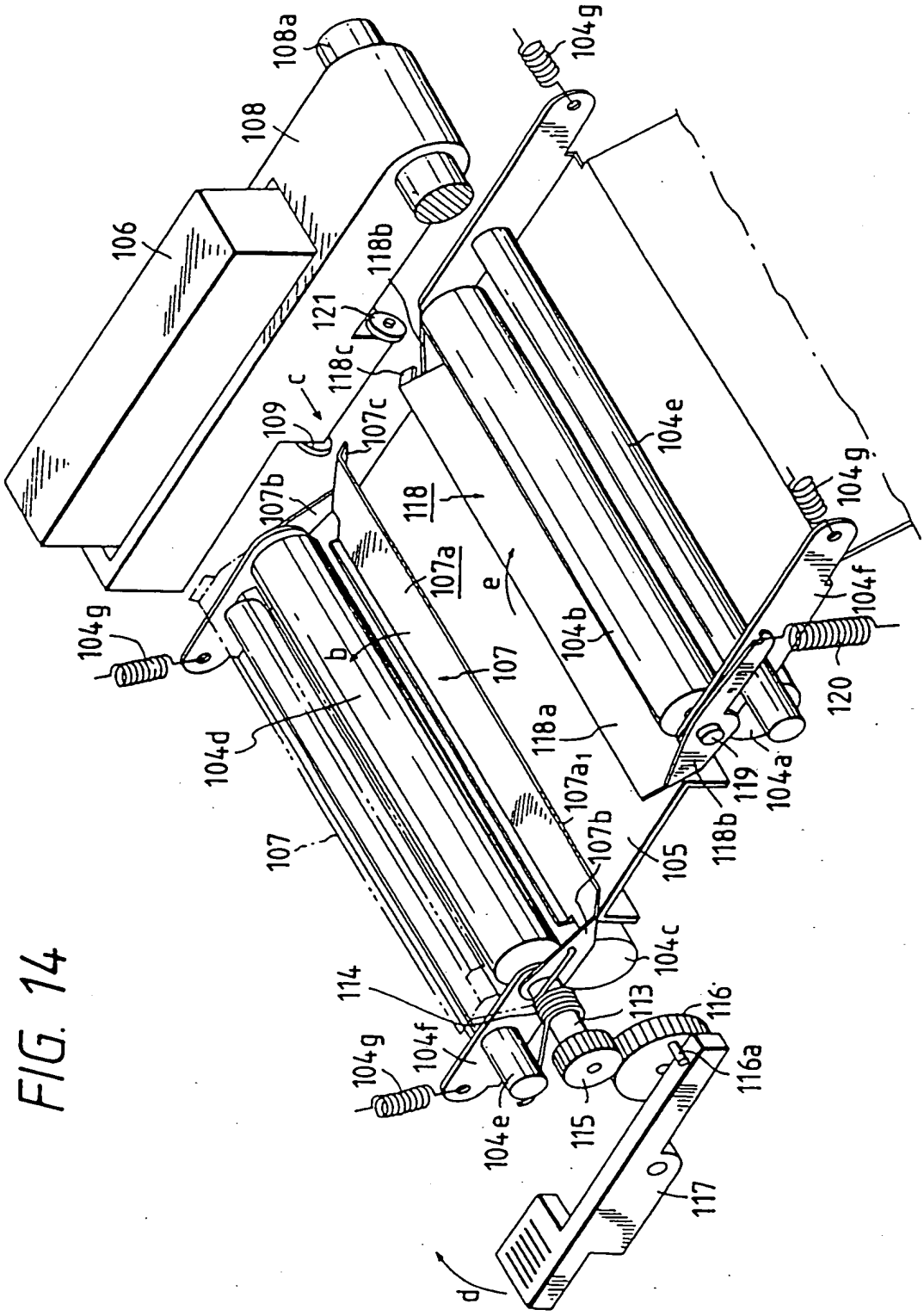
110a
110
131

FIG. 14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d

FIG. 15

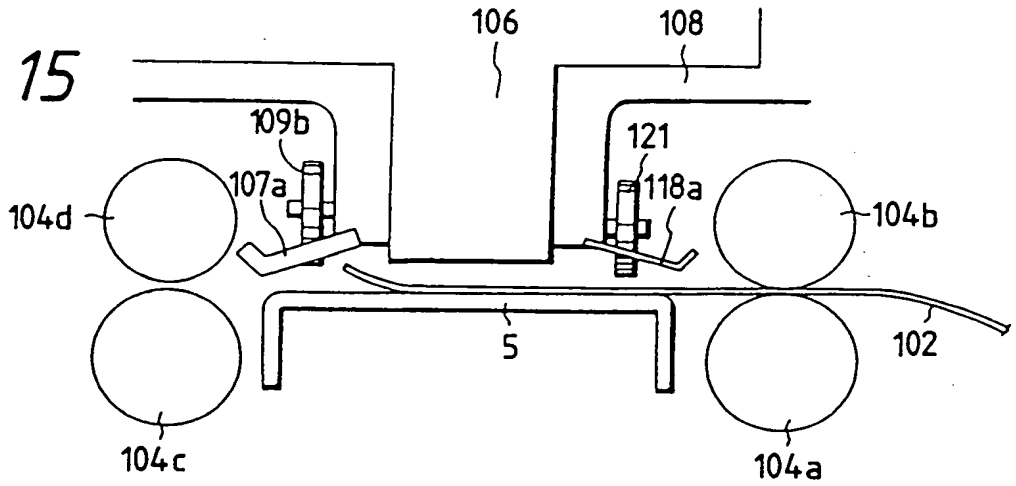


FIG. 16

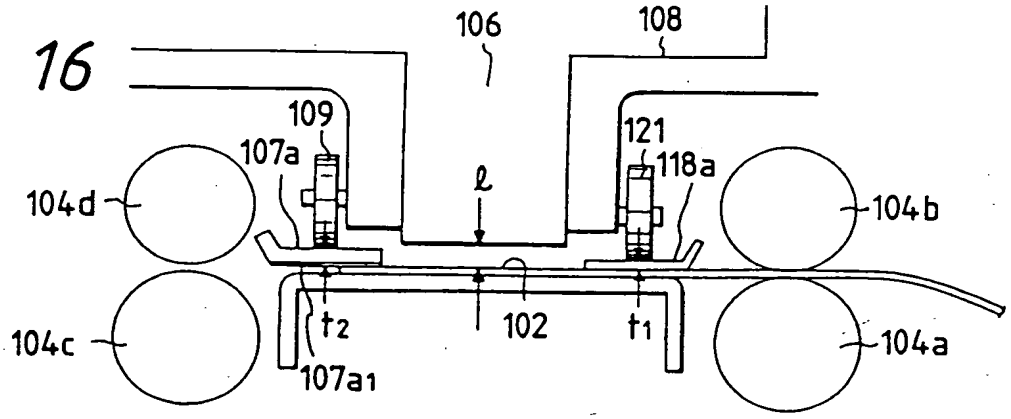


FIG. 17

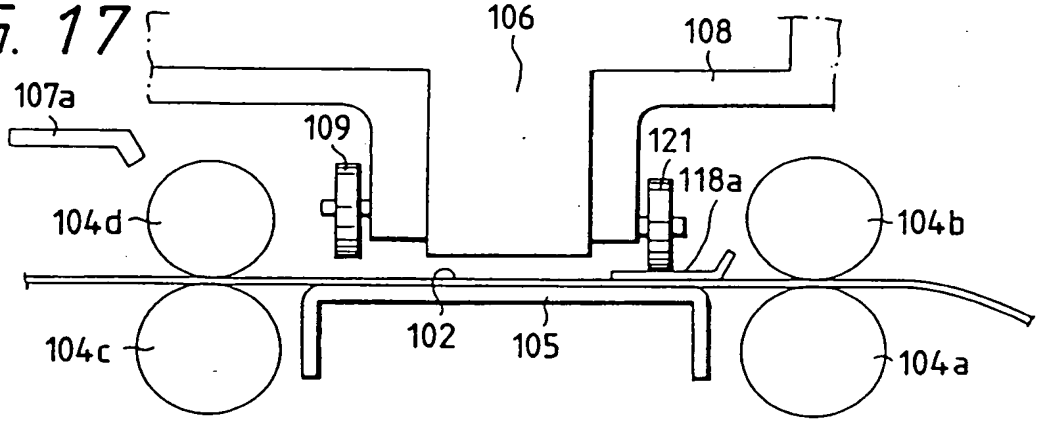
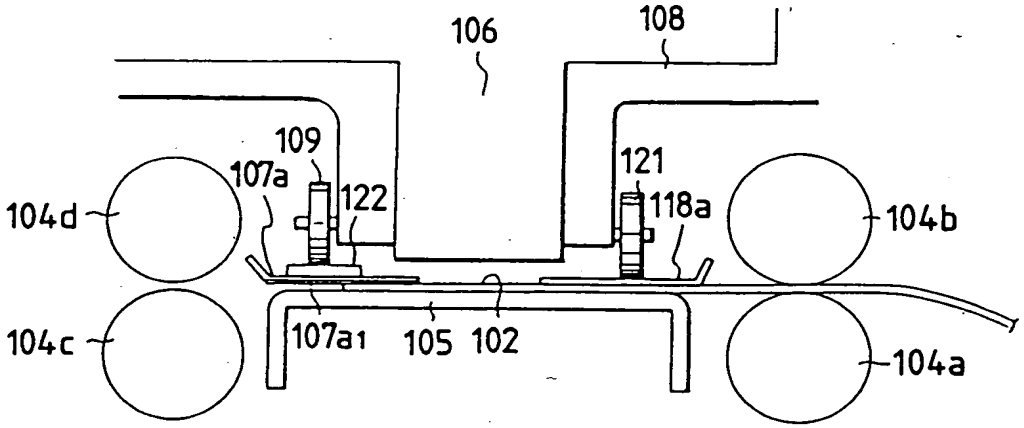


FIG. 18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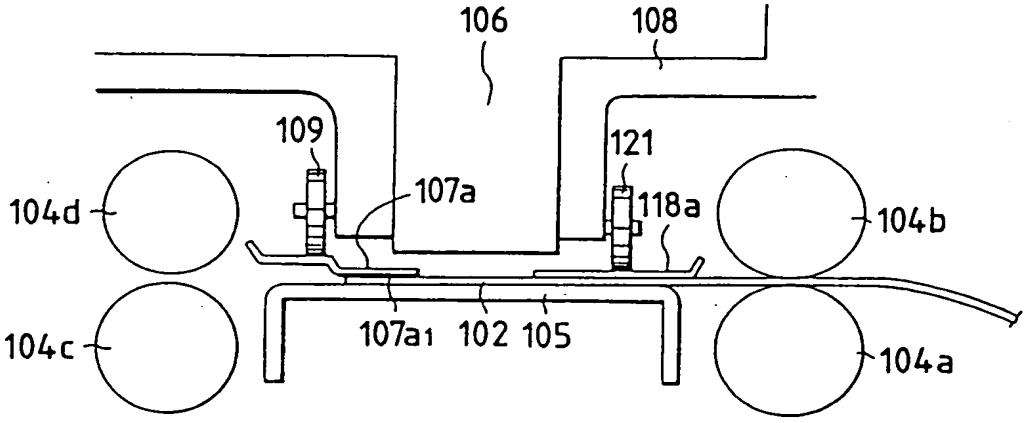
102
104a

FIG. 19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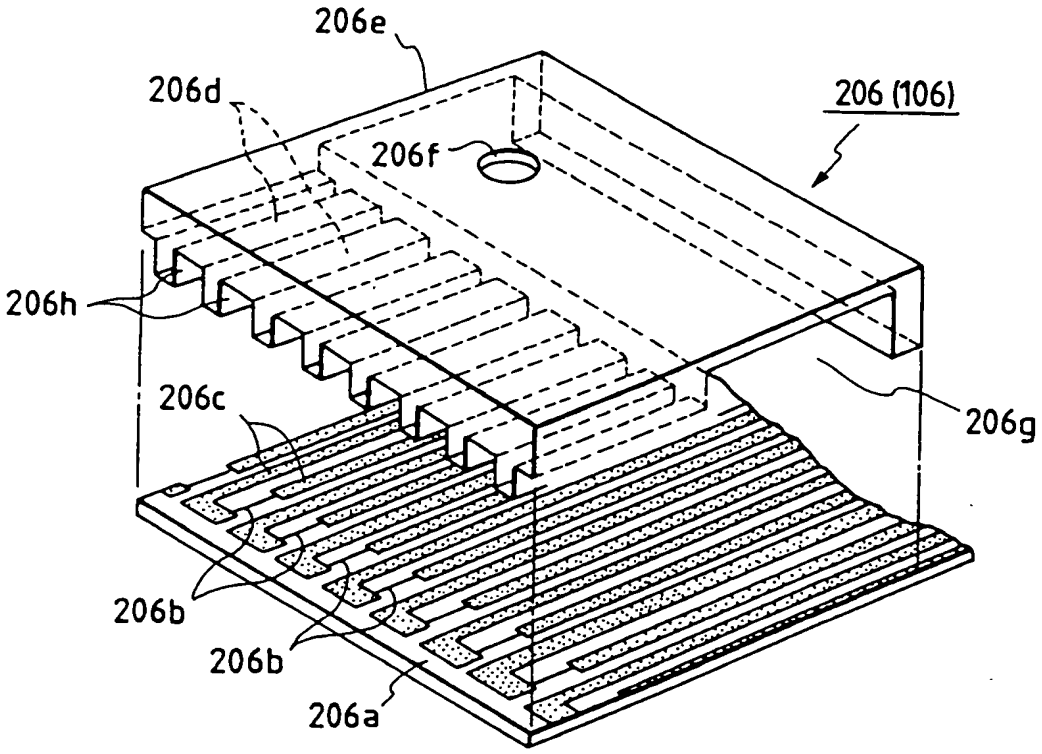
105
104a

FIG. 20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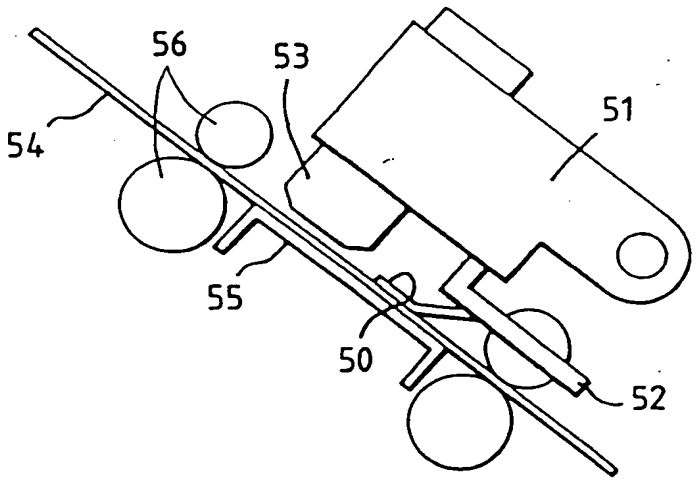
206d
206 (106)
206f
206h
206c
206g
206b
206b
206a

FIG. 22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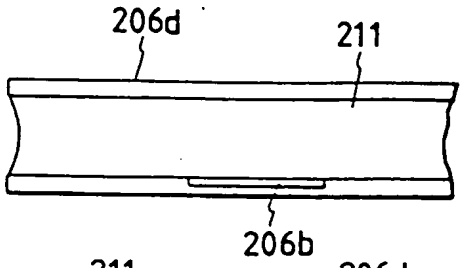

FIG. 21A

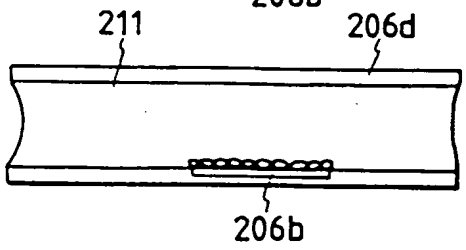

FIG. 21B

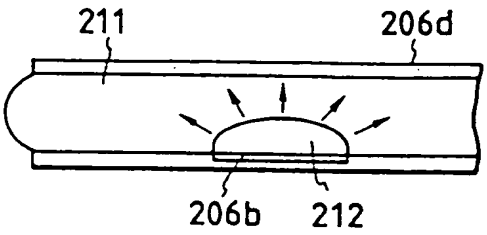

FIG. 21C

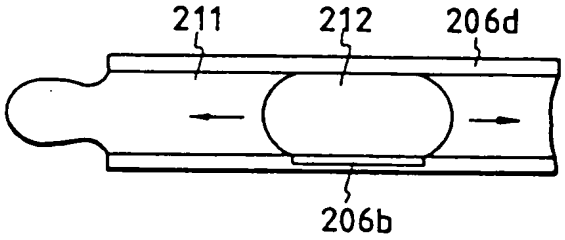

FIG. 21D

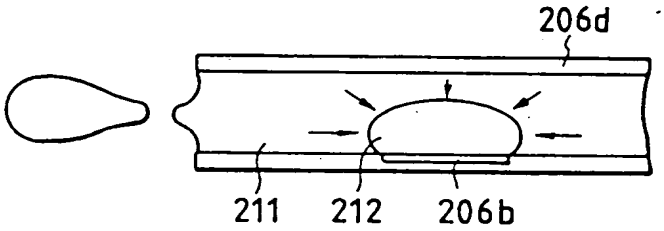

FIG. 21E

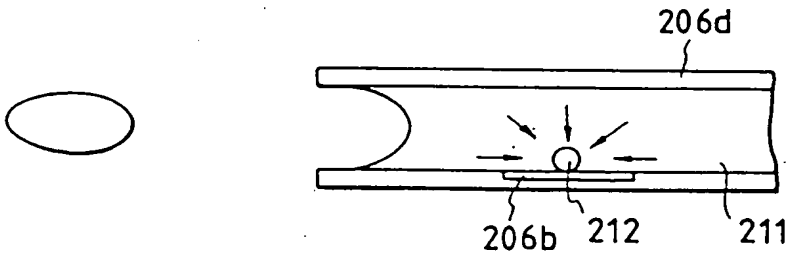

FIG. 21F

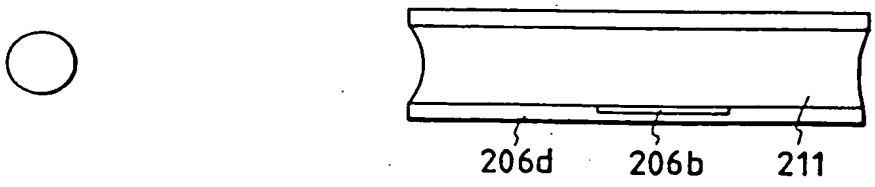

FIG. 21G.